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12-14 June 2007, at US Naval Academy, Annapolis, MD

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Demonstration, _____, Tutorial, _____ or Focus Session # _____

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Semantic Web Technologies for Storing and Accessing Immediately Needed Training Data

*Dr. William (Bill) Gerber
Gabriel Aviles
Karen Fraser
Wayne Randolph*

June 12-14, 2007

Presentation Outline

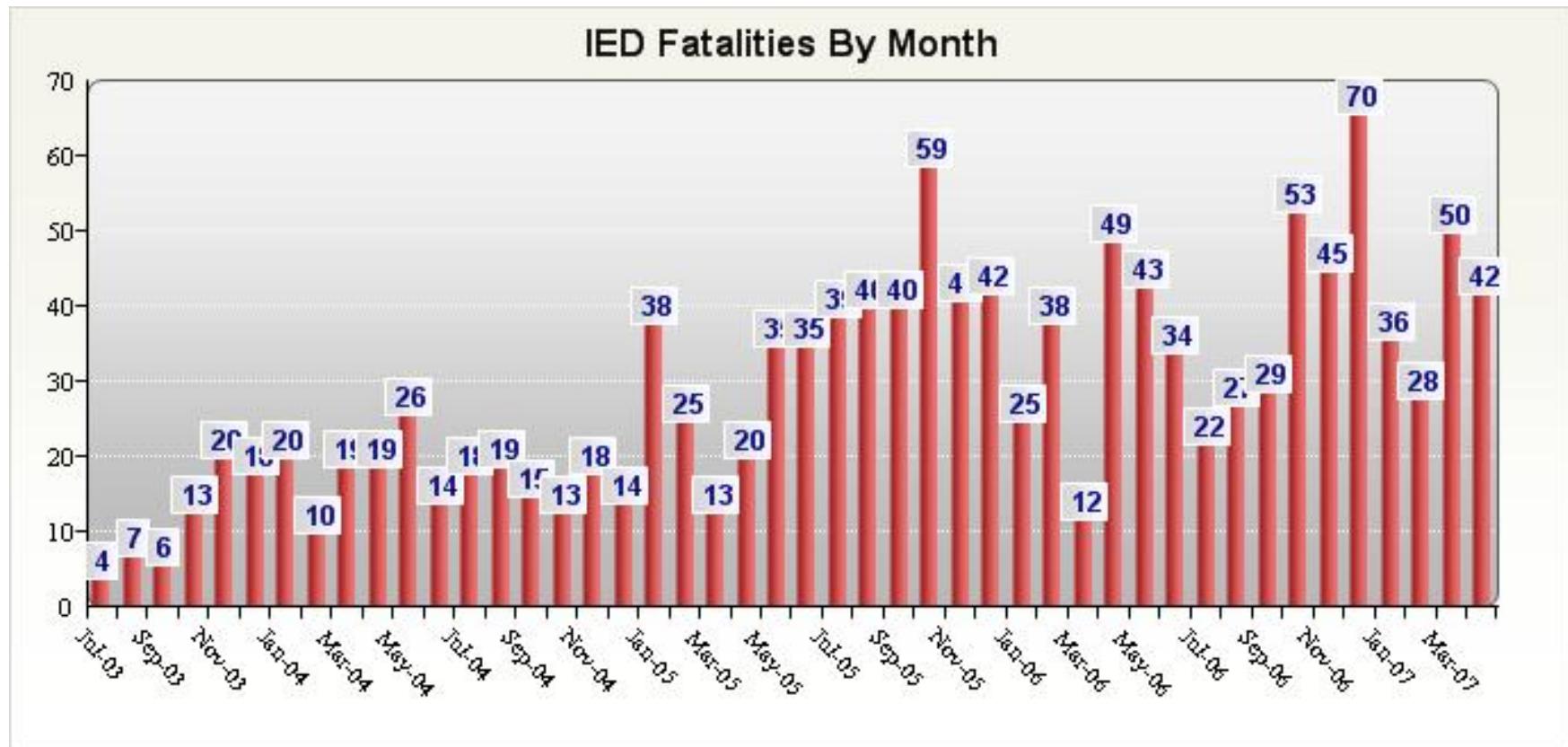
- **Joint Explosive Ordnance Disposal (JEOD) Decision Support System (DSS)**
 - Challenges
 - Overview
- **DARPA - Semantic Web Research**
 - Dynamic Job Aid System (DJAS)
 - Technology Behind the Scenes
- **JEOD Knowledge Transfer Operational Demonstration (KTOD) Advanced Concept Technology Demonstration (ACTD)**
 - Technology Overview
 - Content Authoring Tool (CAT)
 - Reference Assistant Tool (RAT)
- **Summary**
- **Questions**



- **Save Warfighter Lives**
 - EOD warfighters exposed to increasingly sophisticated terrorist improvised explosive devices (IEDs)
 - Inadequate Information Dissemination
- **Enable near real-time dissemination of critical content to mobile users**
 - Deploy network to enable mobile users access to semantic web
 - Near real-time Tactics, Techniques & Procedures (TTP) generation and dissemination
- **Reduce Cost for Procedural Instructional Content**
 - Provide a system to author and publish contextualized content to multiple form factors – *“author once publish many”*

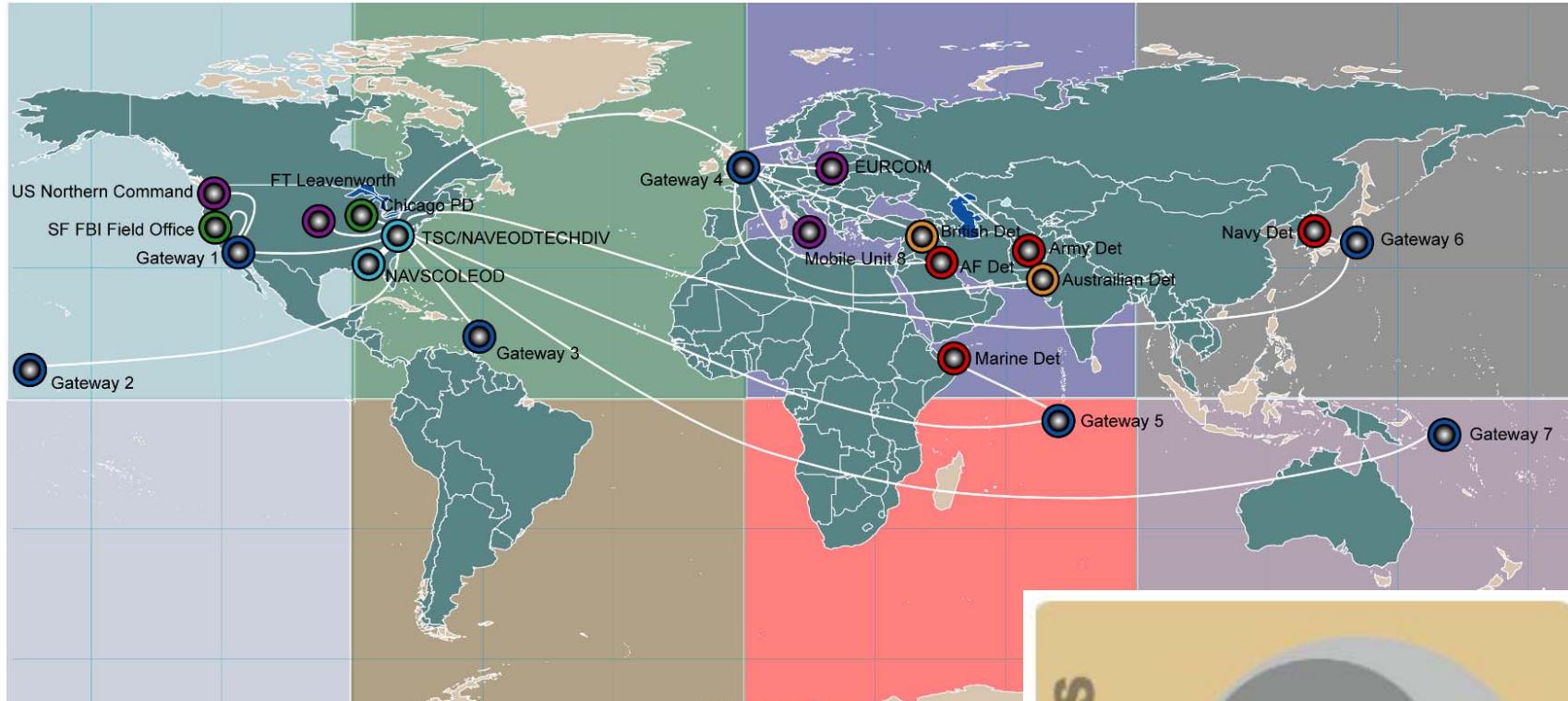


Context: IED US Fatalities By Month

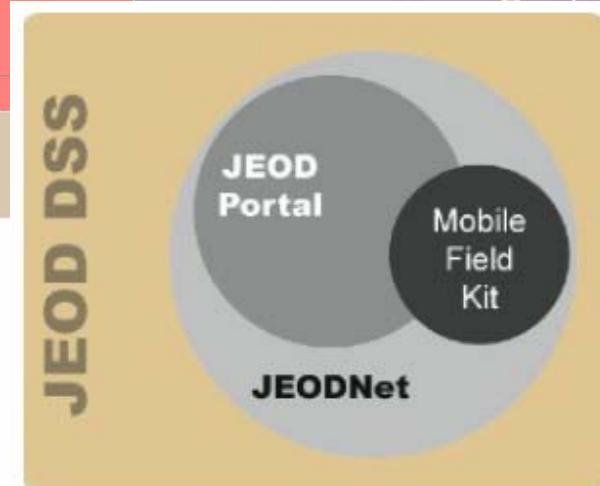


Source: <http://icasualties.org/oif/IED.aspx>

Context: JEOD Decision Support System (DSS) - Globally Deployable



- JEOD Core Site
- JEODNET Gateway
- EOD Detachment
- Operational Commander
- Coalition Partner Detachment
- Civilian or Non-DoD Government Entity

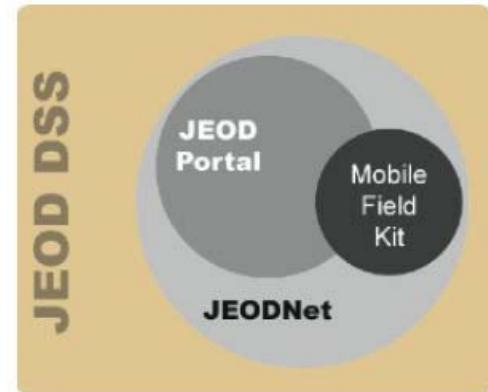


- **Joint Explosive Ordnance Disposal (JEOD) Advanced Concept Technology Demonstration (ACTD) is placing new tools in the hands of EOD techs facing IED threats.**
- **JEOD techs will use the Decision Support System (DSS) to access “just-in-time” Job Aids.**
- **Job Aids help them learn/recall how to perform their mission.**
- **DRC developed tools which leverage Semantic Web technology to:**
 - Reduce development costs of authoring Job Aids by dynamically composing Job Aids from procedural knowledge bases on the fly.
 - Enable “just-in-time” training with tailored instructions based on current conditions (e.g., user roles, weather, location, mission phase, etc.).

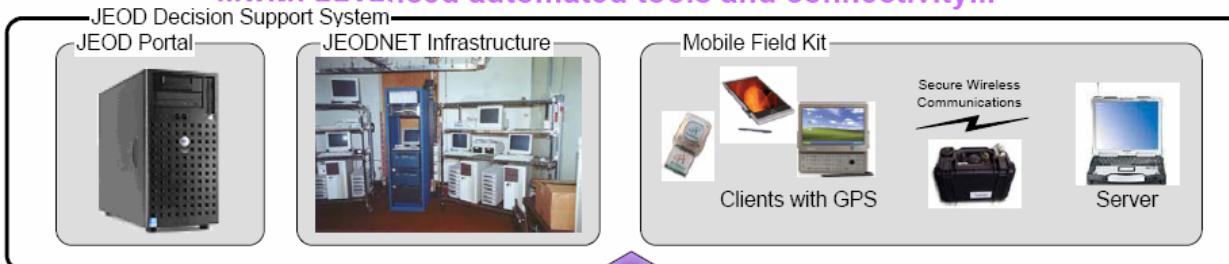
JEOD DSS Overview

Network-Centric JEOD Training, Support, and Operations enabled by the JEOD Decision Support System

Empowering the operational JEOD community's response Teams to counter threats..



...with advanced automated tools and connectivity...



...to the training and support communities



A large, semi-transparent collage of various images is positioned on the left side of the slide. It includes silhouettes of soldiers against a flag, a man working on a vehicle, a man in a flight suit, a map on a screen, a man working on a mechanical component, and the U.S. Capitol building.

Semantic Web Research and Dynamic Job Aid System (DJAS) Demonstration

Funded by DARPA



- **Member of DARPA Agent Markup Language (DAML) research team**
 - Focus on military applications of semantic web technology
- **Leveraged our Training & Performance Support Business Solution**
 - Training/Task Analysis
 - High Performance Team Training
 - Interactive Multimedia Instruction
 - Automated Training Management
- **Developed Dynamic Job Aid System (DJAS)**
 - Instantiated the system with Joint Explosive Ordnance Disposal (JEOD) related content:
 - Tactics, Techniques, and Procedures (TTPs)

- **Proof-of-principle demonstration for filtering and formatting JEOD TTPs using Semantic Web markup**
- **Goals**
 - Domain agility
 - Separation of content from format
 - Context-based filtering (dynamic)
 - Standard representations support sharing and inferencing
- **Demonstration**
 - Auto-author procedural-based instructional information
 - Content contextualized in real-time
 - Content used for just-in-time warfighter training while in the field

Dynamic Job Aid System (DJAS) Demonstration



Dynamic Job Aid System (DJAS) Demonstration
Filtering and Formatting Selection

Select Conditions:

Domain: **ArrLoc-SuspPkg** (highlighted with a red box)

User Role:

- Team Leader
- Master EOD Tech
- Primary Responder (P1)
- Secondary Responder (P2)

Filter Content

[View Source TTP](#)
[View RDF Condition List](#)
[View Filtered TTP](#)

Format Filtered Content:

View Checkbox Format (highlighted with a red box)

View Hyperlink Format

View Expanded Format

View Index Format (highlighted with a red box)

Home **Back**

ArrLoc-SuspPkg (highlighted with a red box)

- ArrLoc-Hostage
- ArrLoc-Vehicle
- ArrLoc-SuspPkg** (highlighted with a red box)
- ArrLoc-WMD
- RecID-SuspPkg-Manual
- RecID-Vehicle-Manual
- RecID-Vehicle-Remote
- RecID-WMD-Remote
- RecID-WMD-Manual
- Neut-Manual-GenDisrup
- Neut-Manual-SrgDisrup
- Neut-Manual-RemRemove
- Neut-Remote-GenDisrup
- Neut-Remote-SrgDisrup
- Neut-Remote-RemRemove
- Neut-Manual-Hostage

Arr/Loc:SuspPkg

[Develop Multiple EOD Courses of Action](#)
[Develop Multiple EOD Courses of Action](#)
[Perform Risk Assessment for Each COA](#)
[Perform Risk Assessment for Each COA](#)
[Consider Wait Time \(Arrival\)](#)
[Consider Wait Time \(Arrival\)](#)
[Tool Selection \(Arrival\)](#)
[Tool Selection \(Arrival\)](#)
[Select Appropriate PPE](#)
[Select Appropriate PPE](#)
[Plan Easy Remote Approach](#)
[Plan Easy Remote Approach](#)
[Plan Safe Manual Approach](#)
[Plan Safe Manual Approach](#)
[Perform Team Brief](#)
[Brief OSC \(Arrival\)](#)

Done **Check All** **Check None**

Arr/Loc:SuspPkg

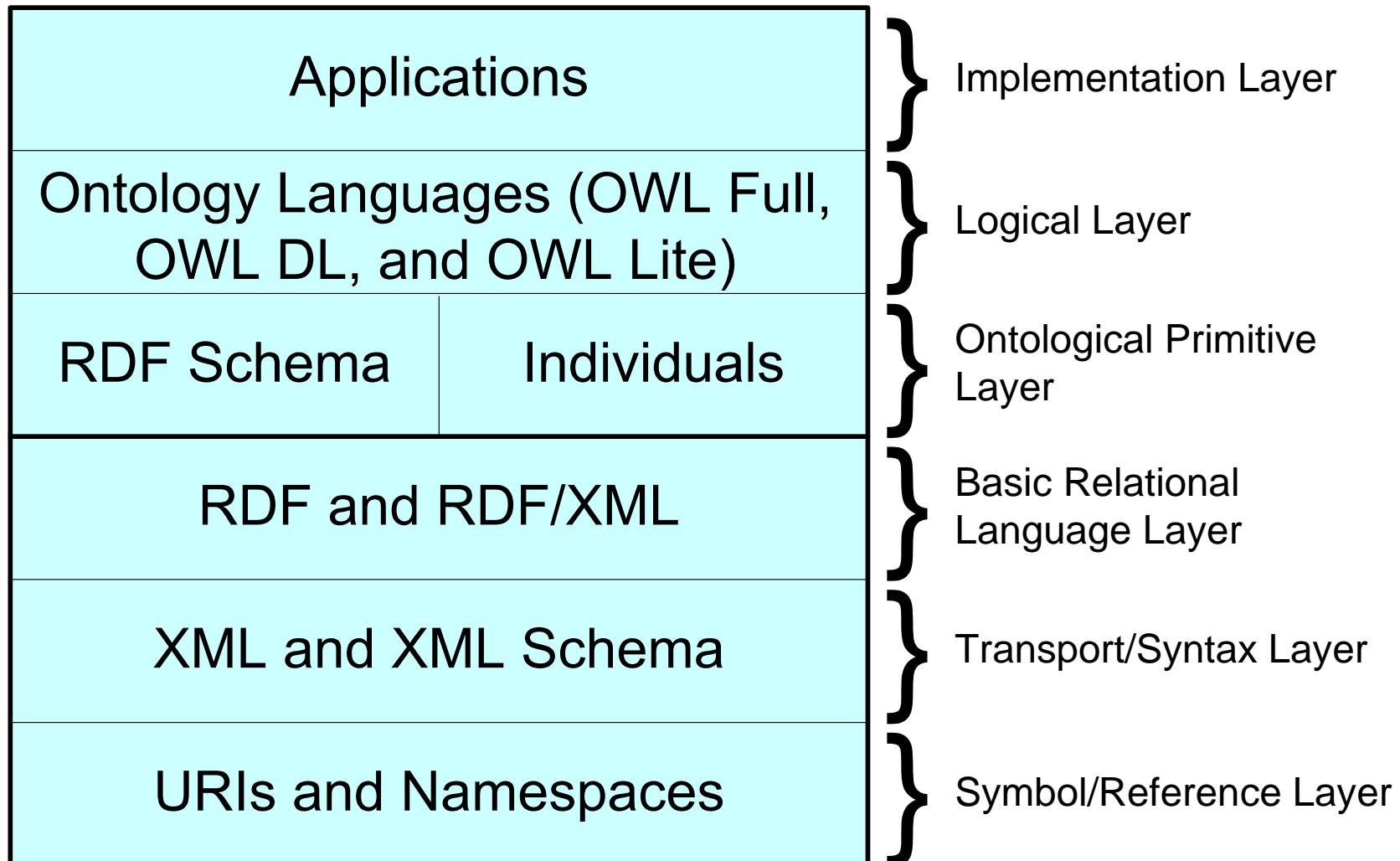
Indexed View

A B C D E F G H I J K L M N O P Q
R S T U V W X Y Z

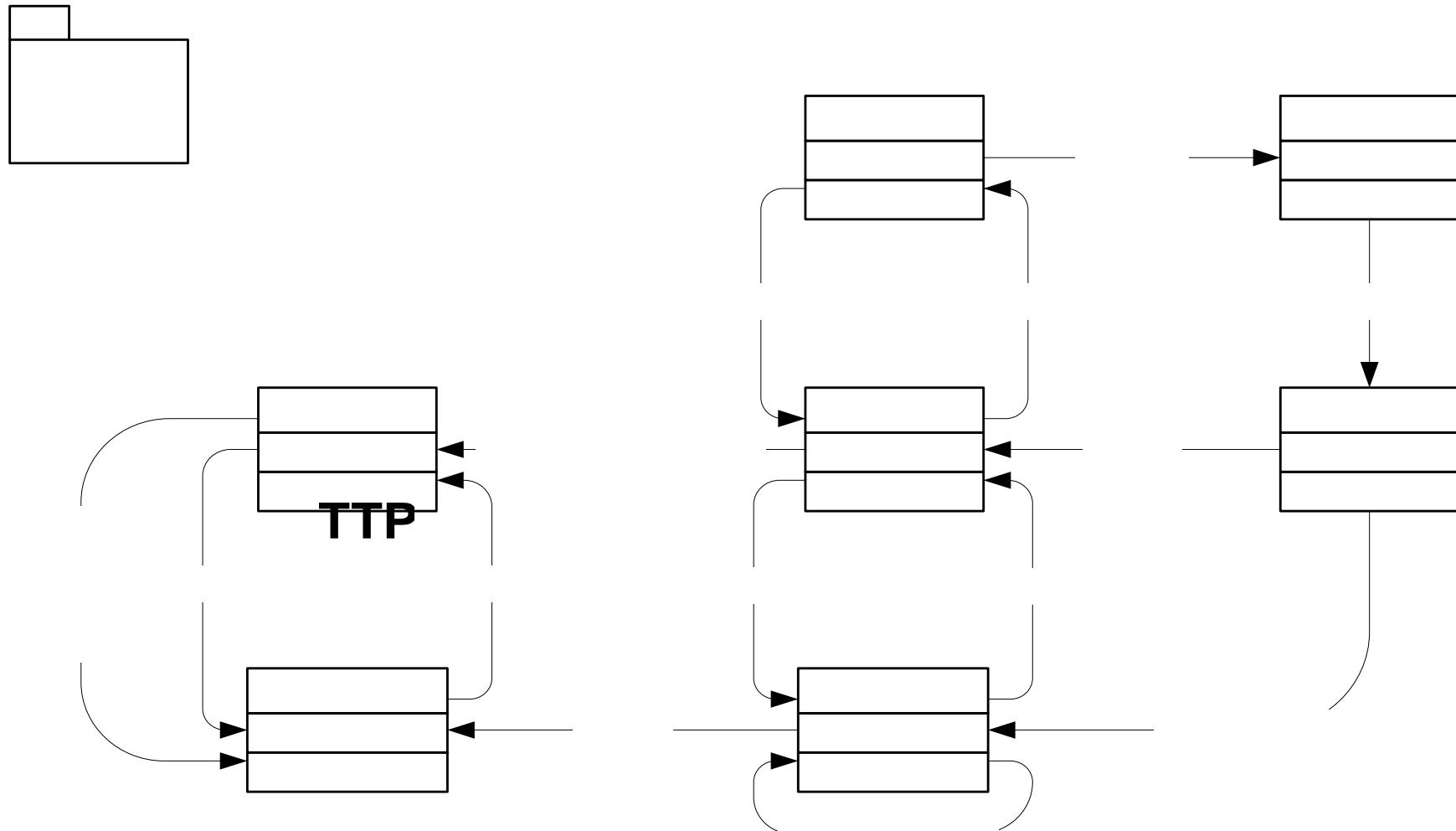
[Index - B](#)
Brief OSC (Arrival)
[Brief entry team](#)
[Be alert for entrapment](#)

- **The Semantic Web is the new evolution of the World Wide Web supported by ontologies.**
- **Ontologies formally specify concepts and their relationships to other concepts.**
 - When classes, subclasses, and relationships among entities expressed in an ontology are defined, they provide a very powerful medium for assisting in the interpretation of the data by software agents.
 - Ontologies can be encoded using the Web Ontology Language (OWL) which received W3C Recommendation Status in 10 February 2004.
 - OWL is built on XML/RDF, adding structure to web content that is required to support automated reasoning.
- **A set of related ontologies form the foundation of the semantic web.**

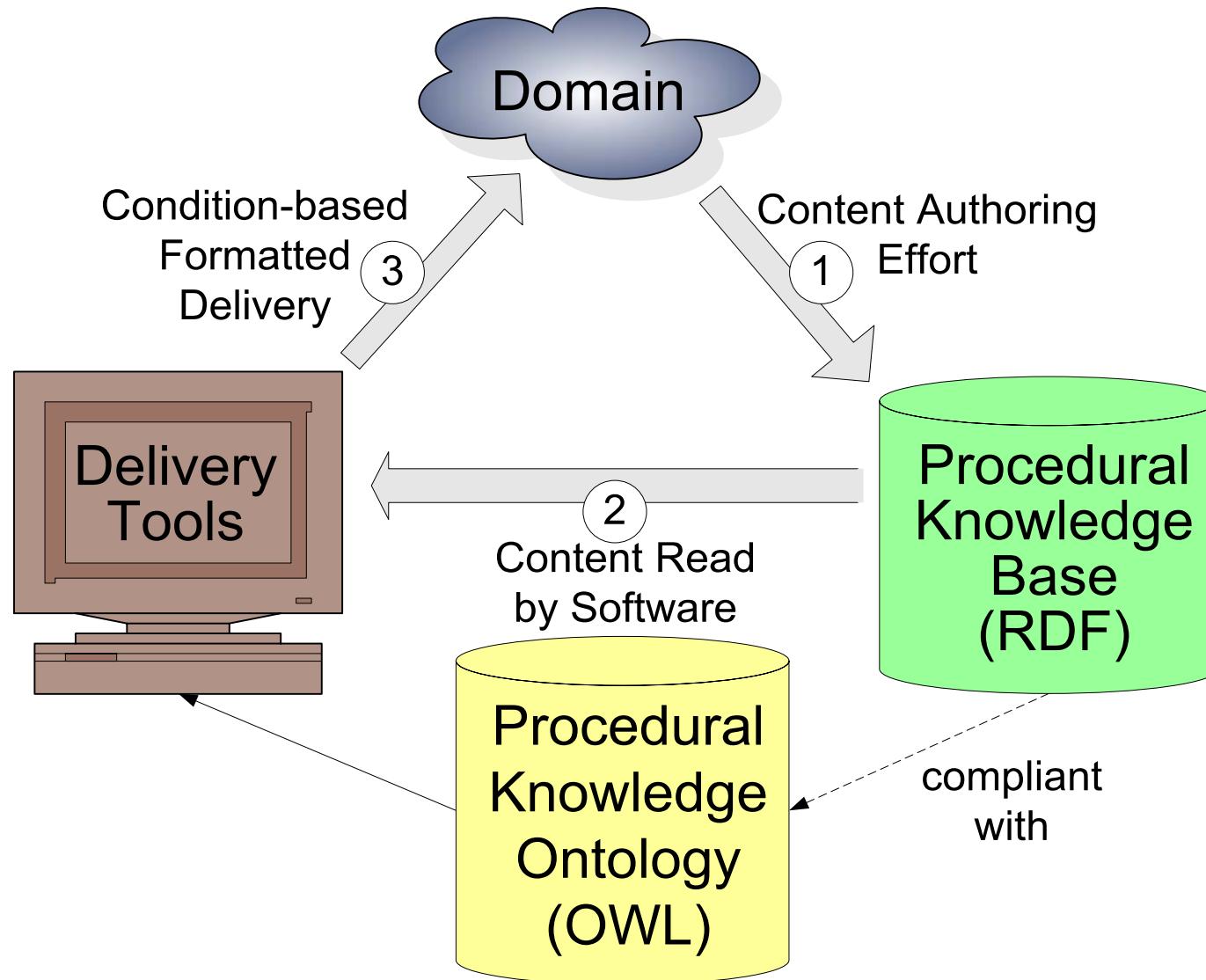




Tactics Techniques Procedures (TTP) Ontology Design



Dynamic Job Aid System (DJAS) Concept Diagram



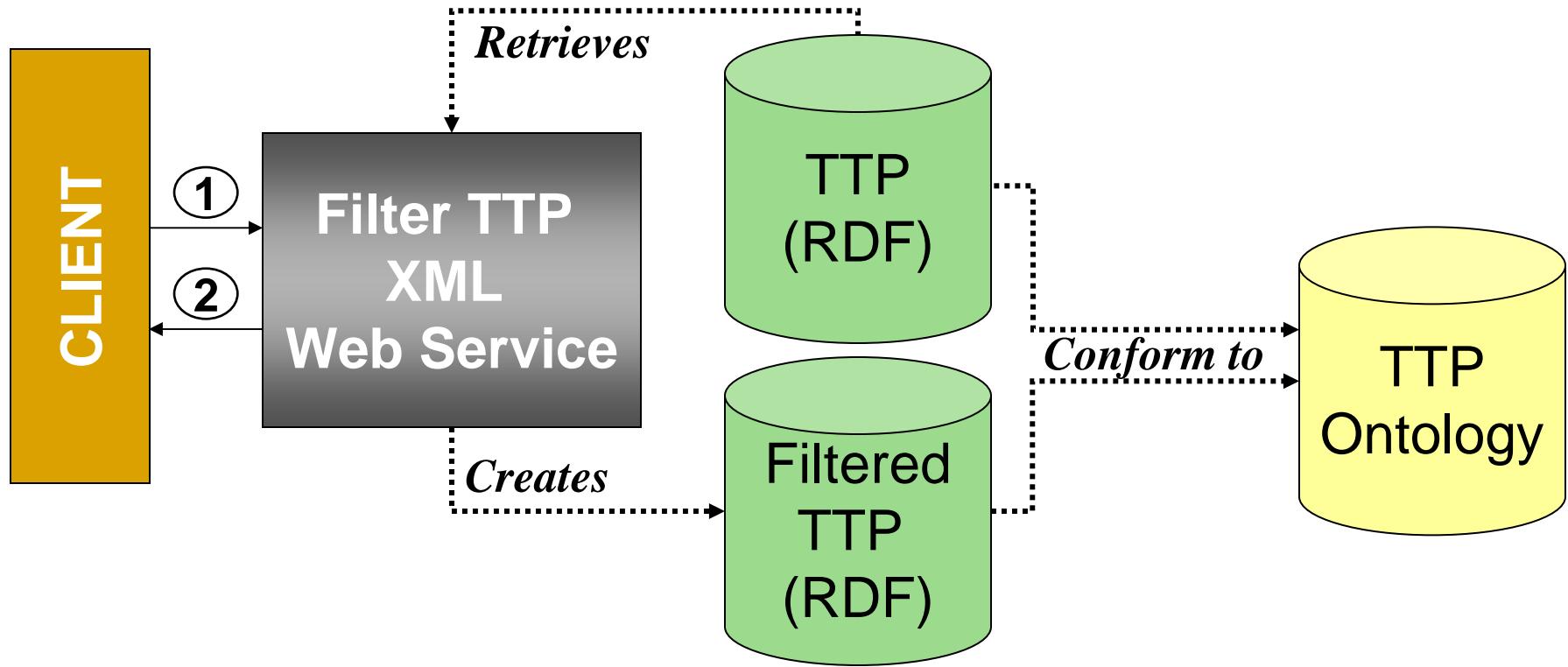
**Filter TTP
XML
Web Service**

- **Filter Web Service**
 - Based on current conditions

**Format TTP
XML
Web Service**

- **Format Web Service**
 - Based on form factor (e.g., handheld, tablet PC) and desired presentation method

DJAS Filter Web Service Component Interaction Diagram



LEGEND

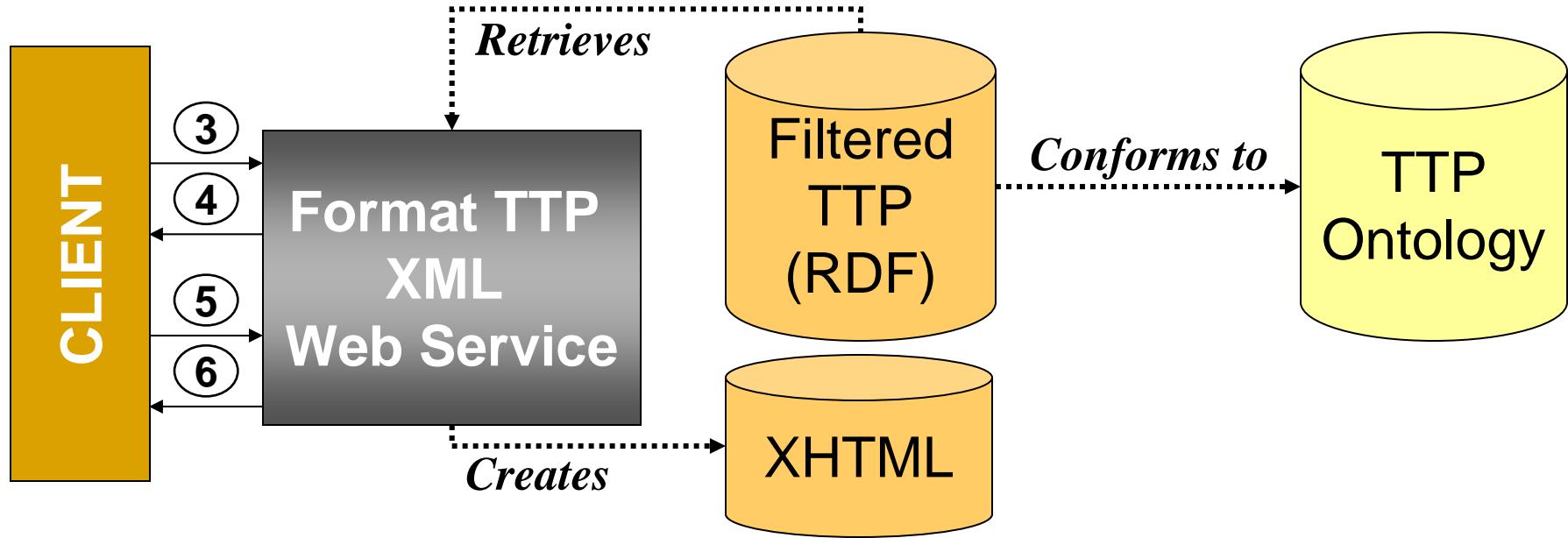
① Client Filter Request with:

- Defined RDF TTP URL
- Defined ConditionNodeSet

② Filter Web Service Response with:

- URL for Filtered RDF TTP

DJAS Format Web Service Component Interaction Diagram



LEGEND

<p>③ Client Format Request with:</p> <ul style="list-style-type: none"> Defined RDF TTP URL Defined FormatType 	<p>⑤ Client Format Request with:</p> <ul style="list-style-type: none"> Defined RDF TTP URL Defined Index
<p>④ Format Web Service Response with:</p> <ul style="list-style-type: none"> URL for XHTML Formatted TTP 	<p>⑥ Format Web Service Response with:</p> <ul style="list-style-type: none"> URL for XHTML Hyperlinked Indexes

A large, semi-transparent collage of various military and scientific images is positioned on the left side of the slide. It includes silhouettes of soldiers against a flag, a man in a flight suit in a cockpit, a dog being checked by a handler, a man working on a vehicle, a map on a screen, a man in a lab coat, and the U.S. Capitol building.

JEOD KTOD ACTD Decision Support System (DSS)

Funded by JEOD KTOD ACTD



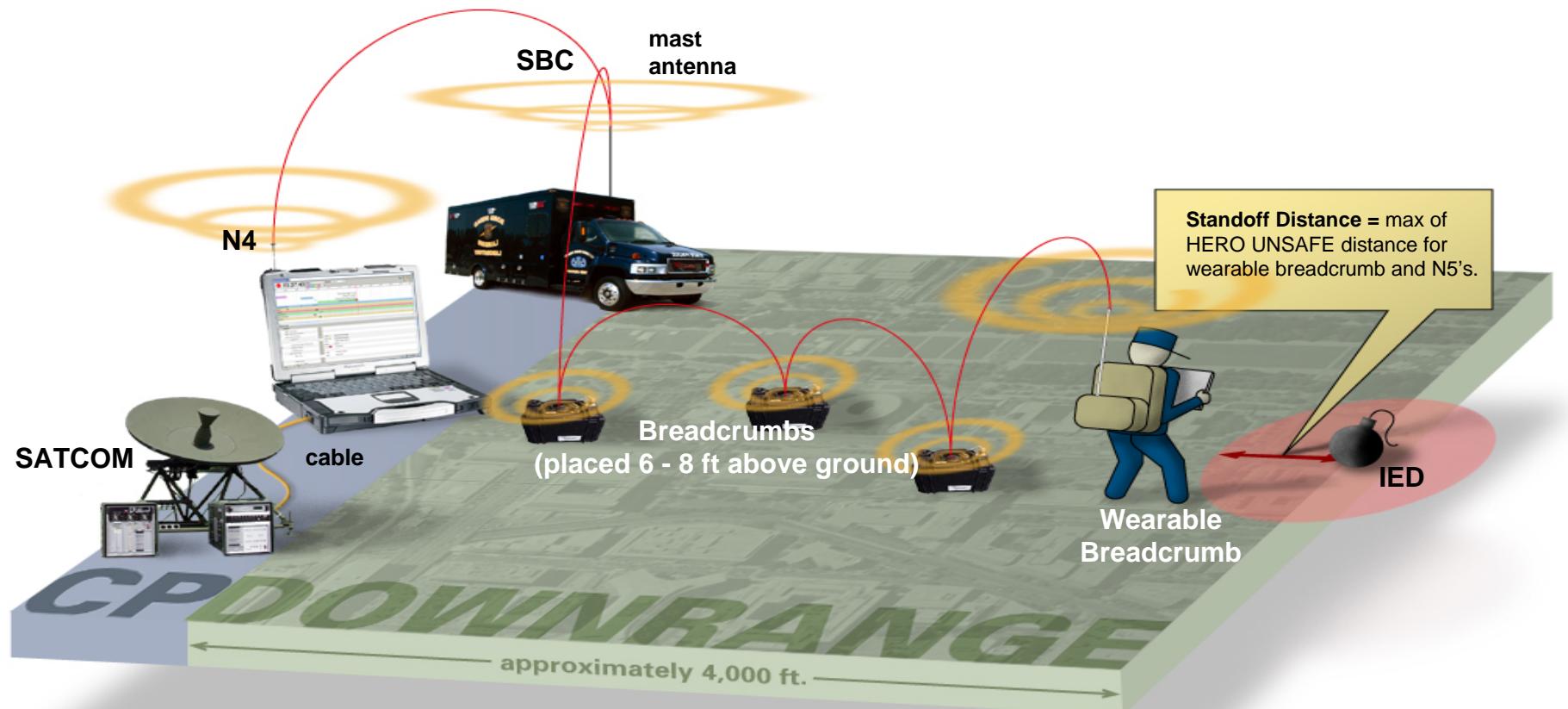
- JEOD Advanced Concept Technology Demonstration (ACTD) recognized the potential of DJAS
- JEOD funded DRC to evolve DJAS into a Reference Assistant Tool (RAT) and to also develop a Content Authoring Tool (CAT)
- RAT is part of the Mobile Field Kit (MFK) of the JEOD Decision Support System (DSS) while CAT supports the content authoring in the Portal
- Initial DJAS TTP Ontology evolved to a suite of ontologies:
 - Mission Ontology
 - Content Ontology
 - Condition Ontology

Military Learning Objective

- Provide contextualized Just-In-Time (JIT) training of procedural content to warfighters while in the field.



Mobile Field Kit (MFK) Technology



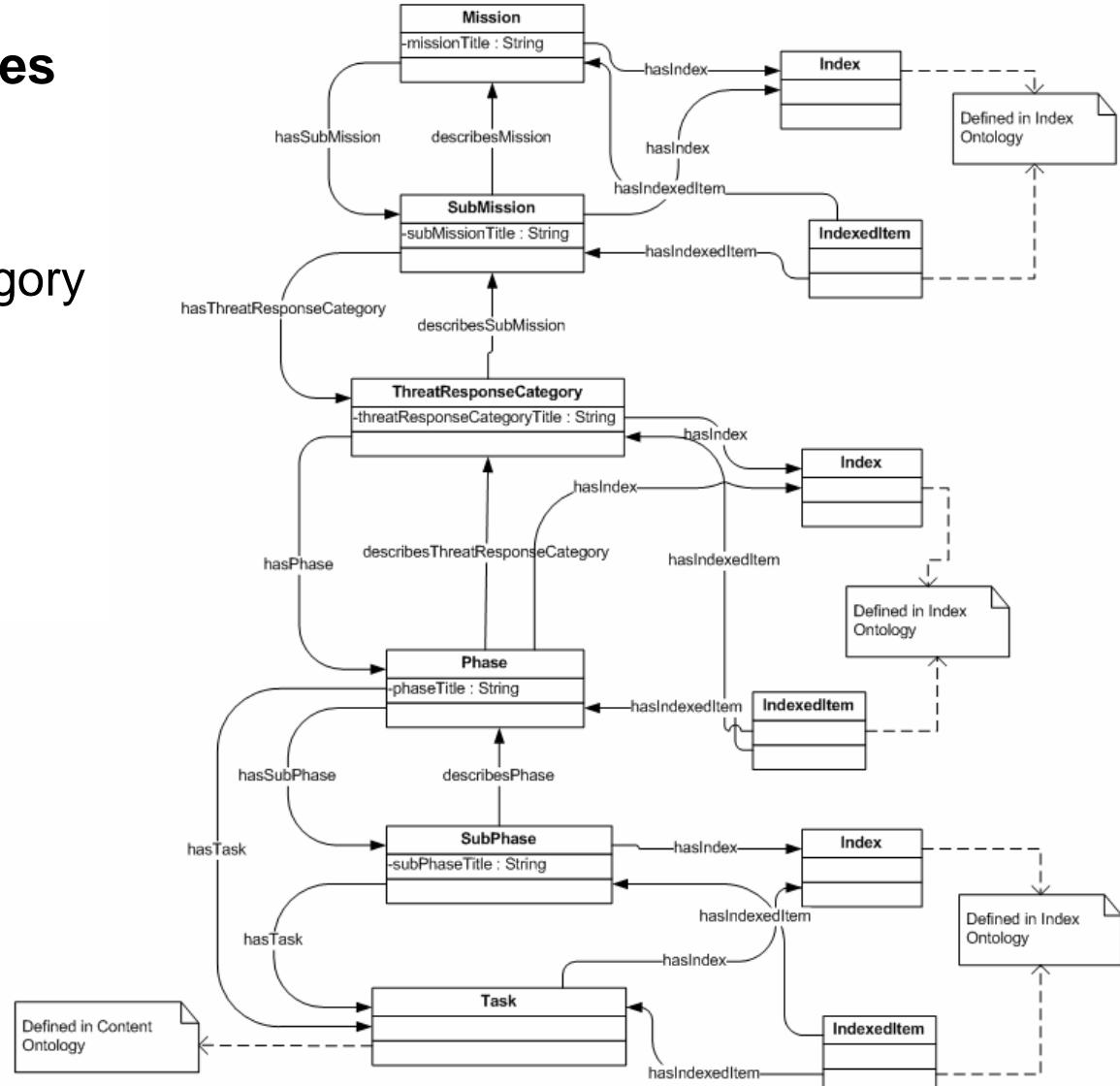
- Identified “just in time” instructional content needed by EOD Techs
- Created ontology suite representing instructional (job aid) material
- Developed a capture tool as part of the JEOD Portal that allows distributed authors to create hyperlinked content by populating a database that generated RDF/XML files compliant with ontology suite
- Created instructional component of the JEOD DSS allowing learners to retrieve context-sensitive (conditions based) training on-the-fly in multiple formats

- Content identified for use in the field by warfighters are **Tactics, Techniques, & Procedures (TTPs) for Improvised Explosive Devices (IEDs)**
- The TTPs may only be applicable to certain **Universal Joint Task List (UJTL) conditions** (ex: weather, terrain, light)

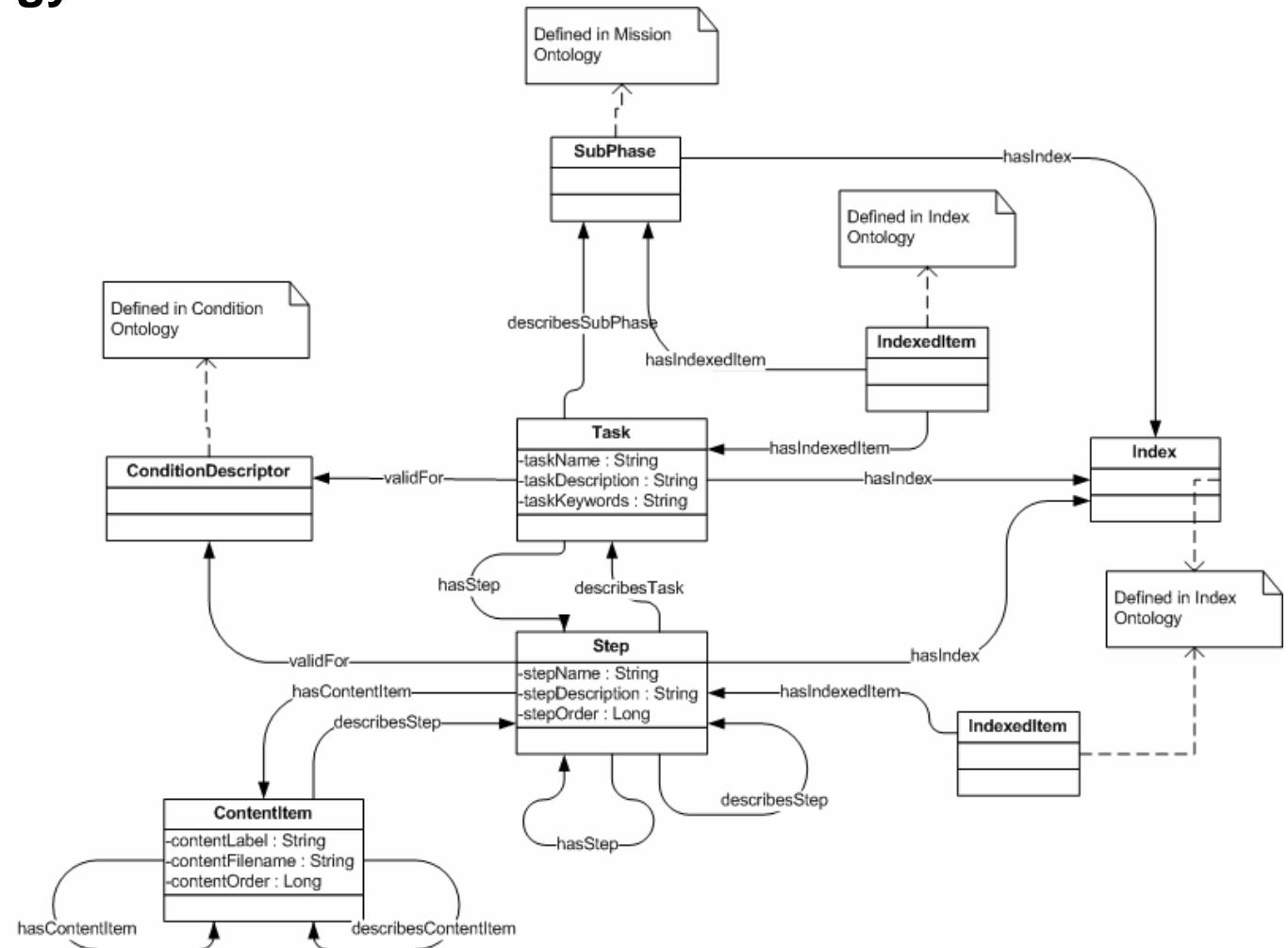


- Developed a set of ontologies to capture the JEOD IED domain
- Ontologies developed describe Mission, Content, and Conditions
- Ontology design documentation used UML-like notation
- Ontology design was used to evolve the design of the database used in the authoring of content

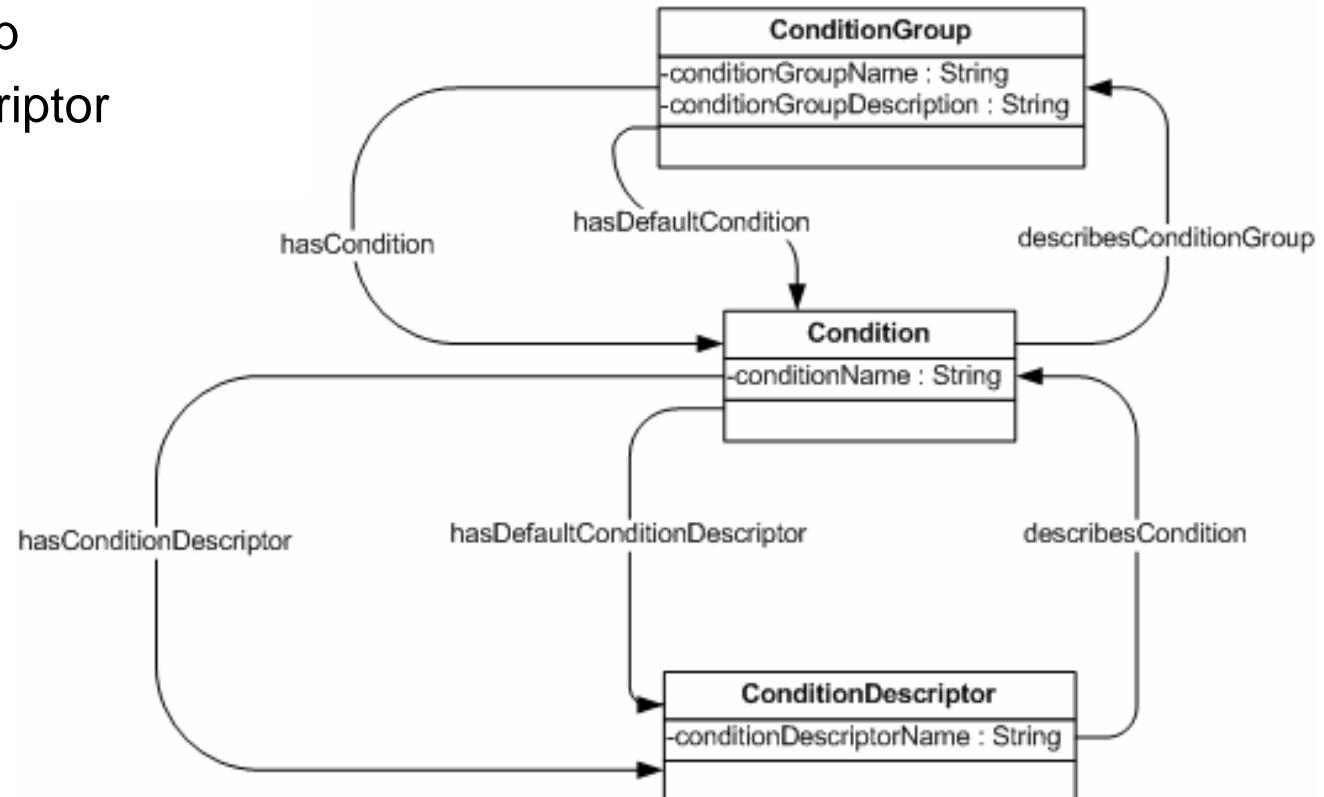
- **Mission Ontology Classes**
 - Mission
 - Sub-Mission
 - Threat Response Category
 - Phase
 - Sub-Phase
 - Task

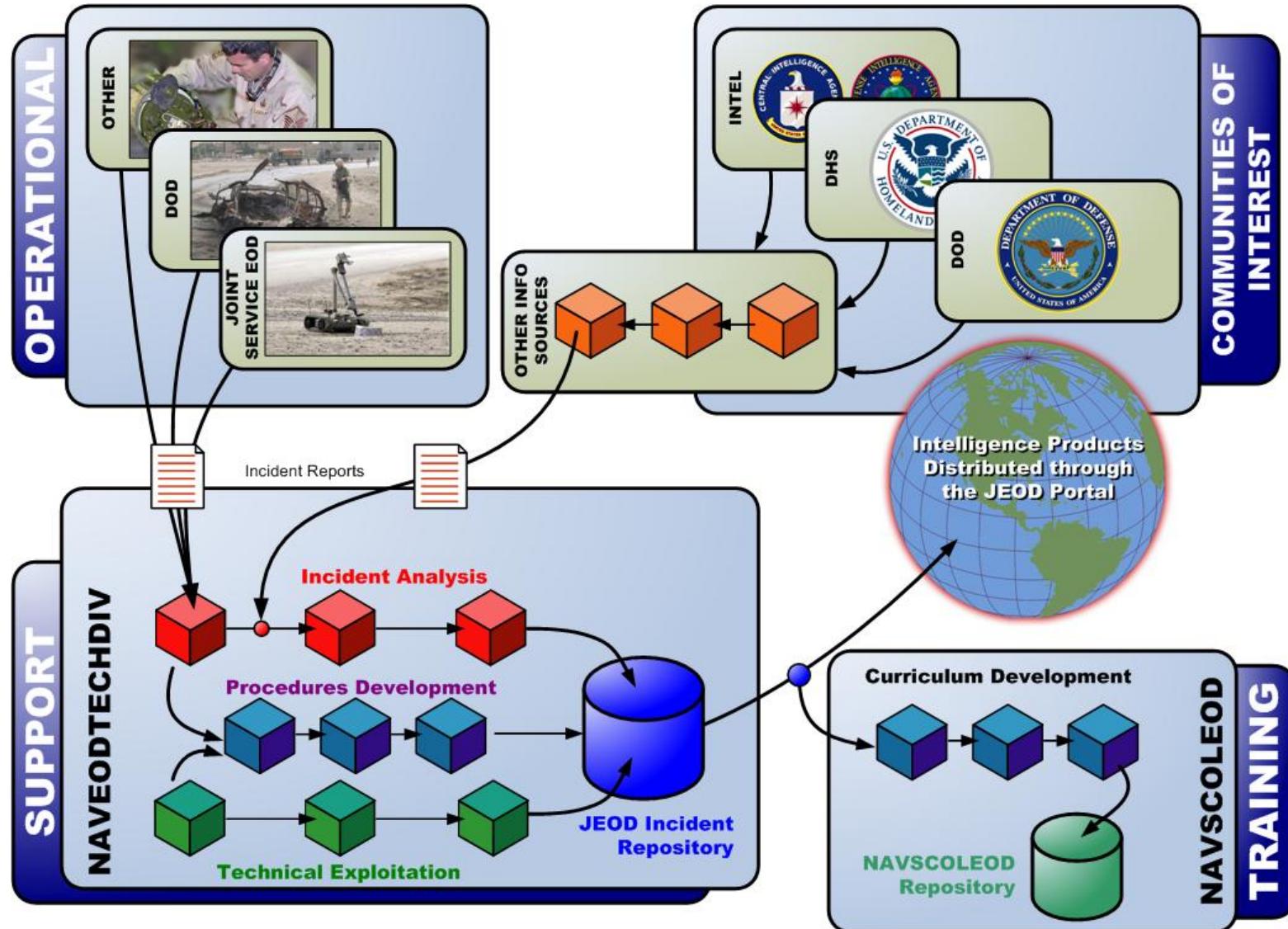


- Content Ontology Classes
 - Task
 - Step
 - Content Item

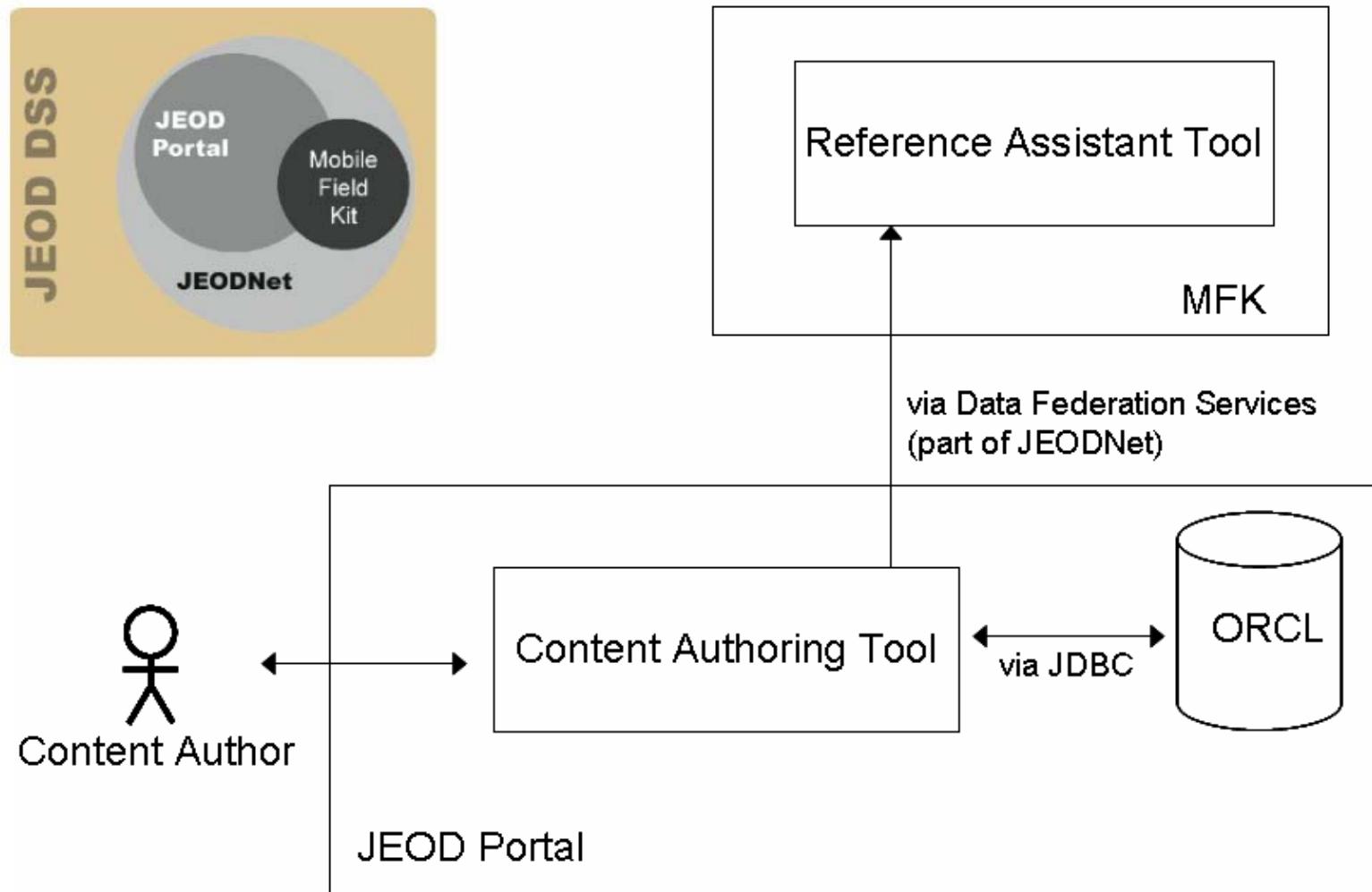


- **Condition Ontology Classes**
 - Condition
 - Condition Group
 - Condition Descriptor





High Level Overview TTP based Tools



A large, semi-transparent collage of various military and scientific images is positioned on the left side of the slide. It includes silhouettes of soldiers against a flag, a man with a dog, a control room with multiple screens, a man working on a vehicle, a man working on a aircraft, and the U.S. Capitol building.

Content Authoring Tool (CAT) J2EE Portlet

Funded by JEOD KTOD ACTD



- Developed a Content Authoring Tool portlet on the JEOD Portal that allowed distributed authors to create TTP content
- Authored TTP content populated an Oracle database that generated RDF/XML files compliant with the JEOD ontology suite
- Content Authoring Tool (CAT) allowed authors to assign conditions to the developed content

Content Authoring Tool

Add Steps – Sub Steps

JEODNET

DISCLAIMER: JEODNet Portal DEVELOPMENT VERSION

Welcome, Karen Fraser! 

Home IFIS ThinkMap AEODPS-NG GIS Lexicon CAT

Content Authoring Tool

Step Information Task Information Organize Tasks List Maintenance Utilities Home

Add Step

1

Step Name:

Sub-Steps Content Conditions References

2

Sub-Step Name Add Clear

3 4

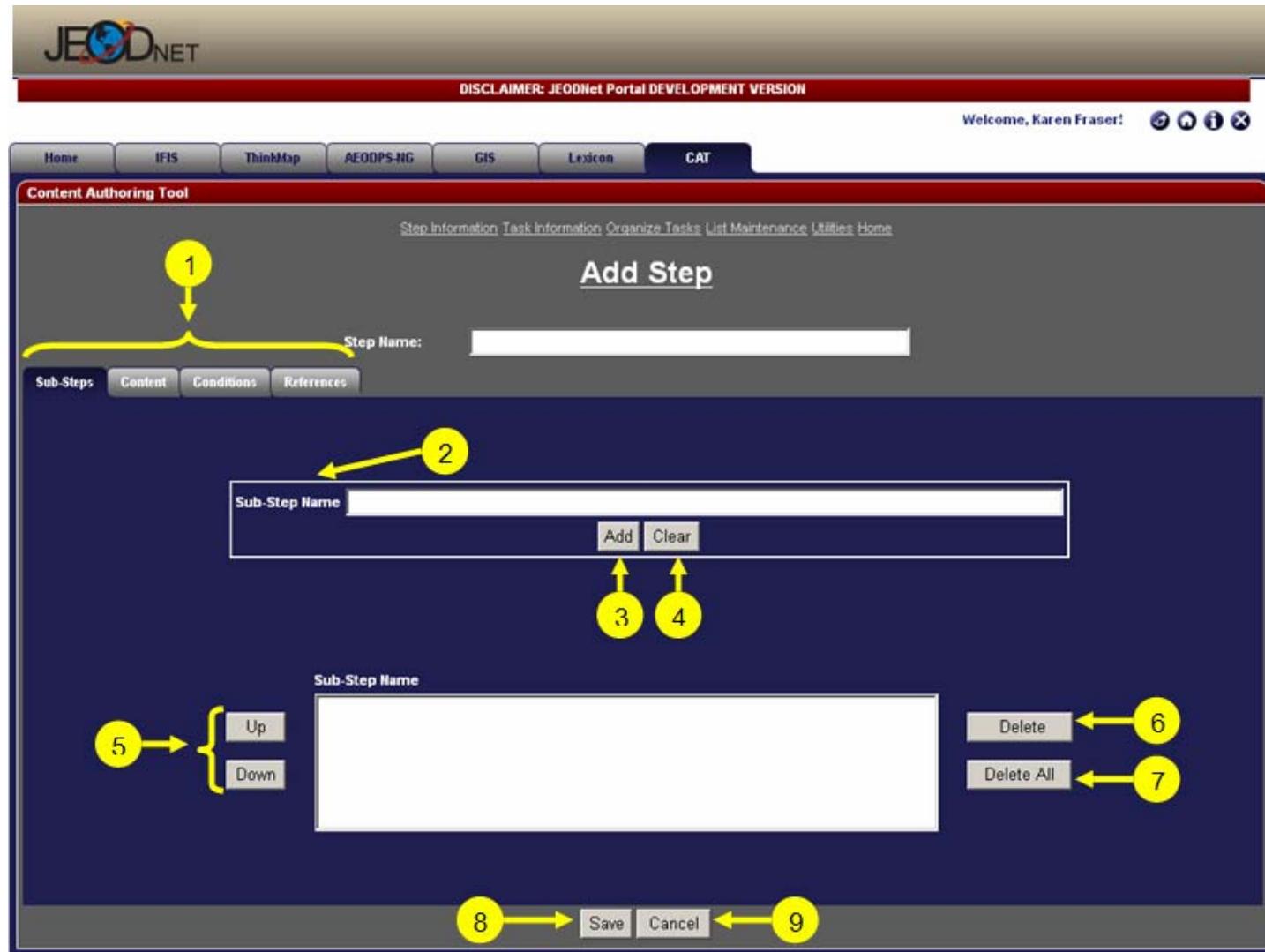
5

Sub-Step Name Up Down

6 7

8 9

Save Cancel



Content Authoring Tool

Add Step - Conditions

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Content Authoring Tool

Step Information Task Information Organize Tasks List Maintenance Utilities Home

Add Step

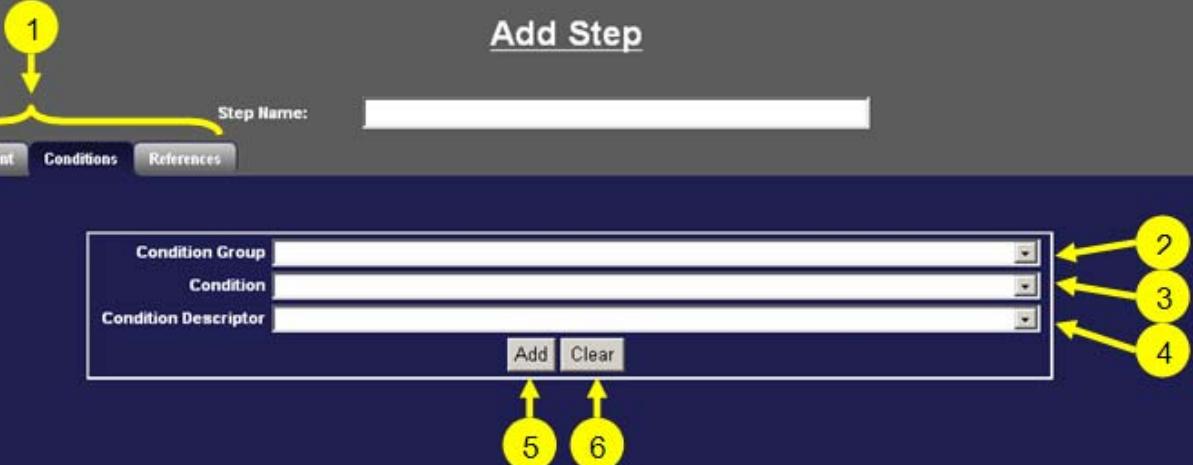
Step Name:

Sub-Steps Content Conditions References

Condition Group Condition Condition Descriptor

Add Clear

Condition Group Condition Condition Descriptor


 1: Step Name input field
 2: Condition Group dropdown
 3: Condition dropdown
 4: Condition Descriptor dropdown
 5: Condition Group input field
 6: Condition input field
 7: Delete button
 8: Delete All button

Save Cancel

Content Authoring Tool

Add Task - Steps

JEODNET

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Home IFIS ThinkMap AEOOPS-NG GIS Lexicon **CAT**

Content Authoring Tool

Step Information Task Information Organize Tasks List Maintenance Utilities Home

Add Task

Task Name: 1

Task Keywords: 2

Steps Conditions References

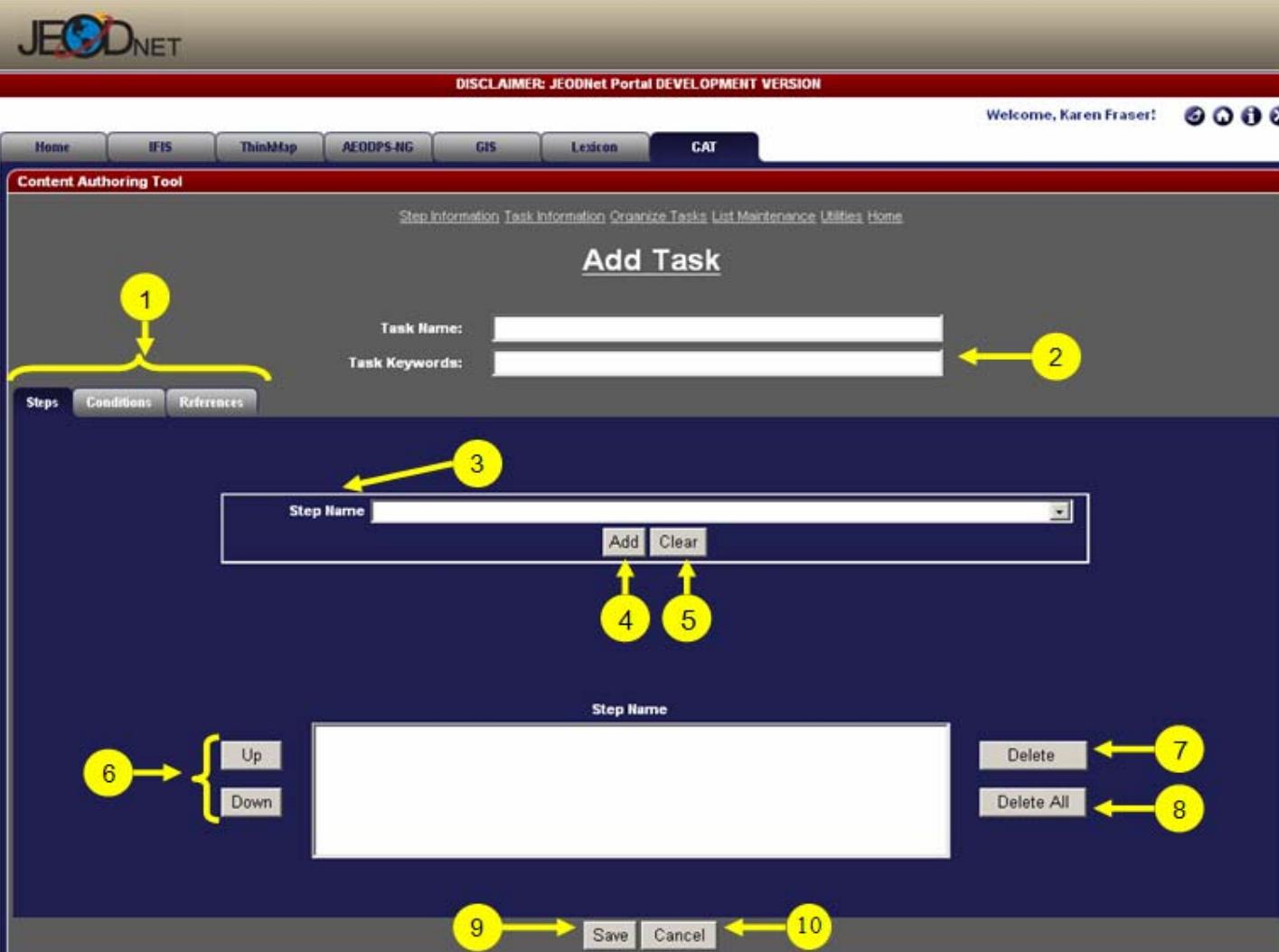
Step Name 3

Add Clear 4 5

Step Name 6

Up Down 7 8

Save Cancel 9 10



JEODNET

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Content Authoring Tool

Step Information Task Information Organize Tasks List Maintenance Utilities Home

Add Task

1

Task Name:

Task Keywords:

Steps Conditions References

2 3 4

Condition Group

Condition

Condition Descriptor

Add Clear

5 6

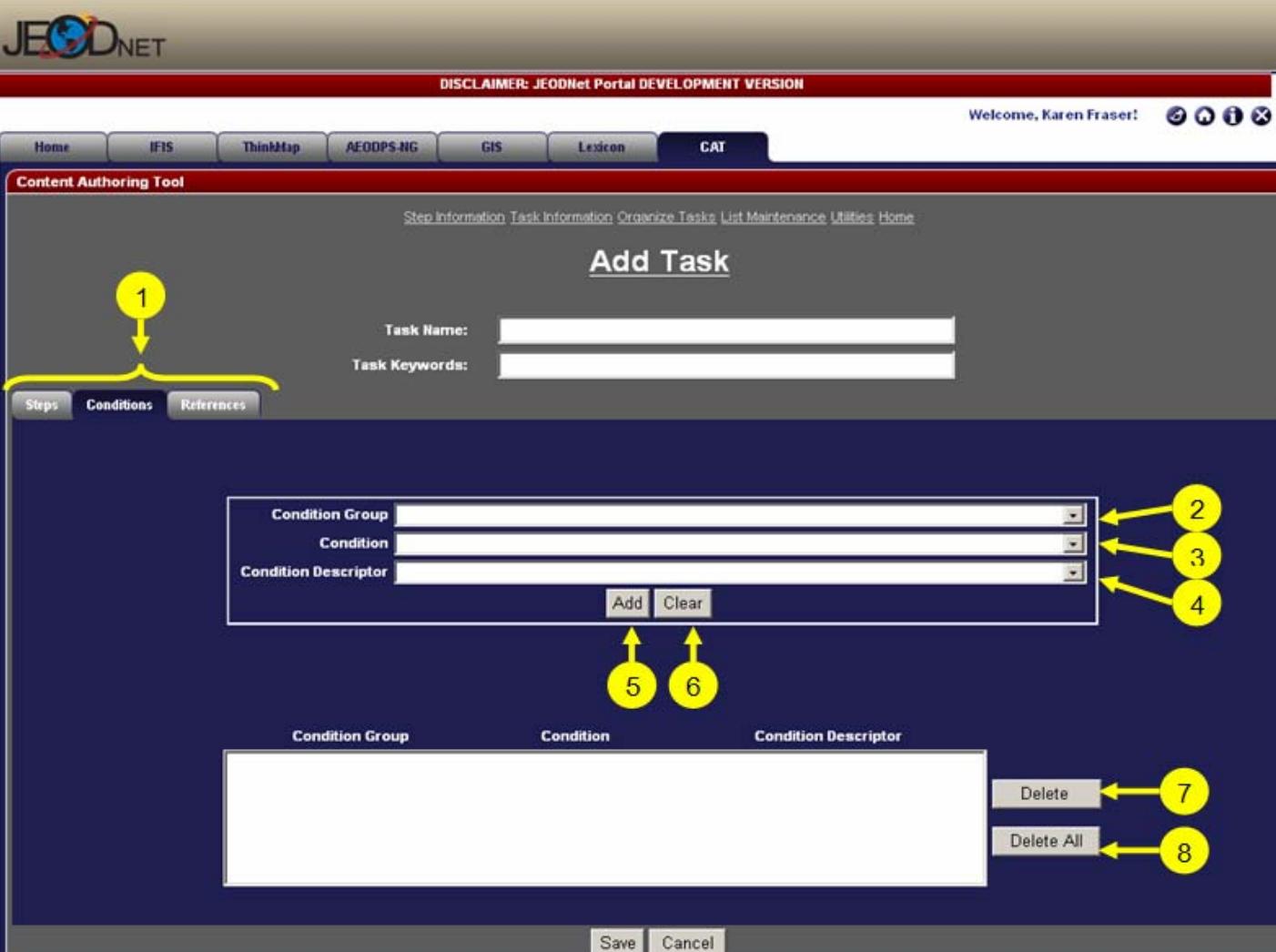
Condition Group Condition Condition Descriptor

7 8

Delete

Delete All

Save Cancel



A large, semi-transparent collage of various military and scientific images is positioned on the left side of the slide. It includes silhouettes of soldiers against a flag, a man with a dog, a man in a flight suit, a man working on a vehicle, a man working on a large piece of equipment, a map on a screen, and the U.S. Capitol building.

Reference Assistant Tool (RAT) on JEOD DSS Mobile Field Kit

Funded by JEOD KTOD ACTD



- **Enables the warfighter to search the knowledge base for instructional content**
- **The search results are filtered based on system conditions**
- **The RAT allows the user to retrieve context-sensitive (condition based) training formatted on-the-fly based on the users' form factor**
- **The user is allowed to override system conditions which triggers a real-time re-authoring of the training materials**

- **Resides on Mobile Field Kit (MFK)**
 - part of the JEOD Decision Support System (DSS)
 - installed on Tablet PC platform
- **Searches knowledge base for instructional content requested by warfighter (mobile user)**
 - speech to text capability
 - natural language processing capability
- **Filters search results based on current conditions**
 - MFK can receive condition updates from sensors
- **Retrieves context-sensitive training formatted for user's form factor on-the-fly**
- **Triggers immediate re-authoring of the training materials based on user's decision to override current conditions**

Reference Assistant Tool (RAT) Demonstration

Mobile Field Kit - Incident #1; User , D

Reference Assistant Tool

Search for: how do I use a remote adapter

All Content

read results 5
Results can be read aloud.

search history 1
User is able to move back and forth through search history.

TPP content 2
Tactics, Techniques, and Procedures are available for searching.

legacy content 3
More supported formats for searching: XML, HTML, XHTML, RDF, PDF, DOC, XLS, PPT, TXT, RTF.

lexicon terms 4
Terms and definitions from the default EOD lexicon available for searching.

Results:

- 1) [TSK1058557779264.rdf](#)....TPP content
Score = 9.0%
- 3) [STP1061323255932-d4e52.rdf](#)....TPP content
Score = 8.0%
- 4) [antennasdata.pdf](#)....Legacy content.
Score = 8.0%
- 2) [Antennas.pdf](#)....Legacy content.
Score = 2.0%
- Lexicon Content
 - adapter**
 1. Mechanical. Any modifying part, piece, or device, designed to facilitate connection, provide accommodation, enable application.
 2. Electrical. An item that provides the necessary accommodations to electrically connect two or more items whose design or function is not compatible.

Synonyms: /

Score 100.0%

A

 1. In such usage as M18A3, designates an accepted modification of a standardized item.

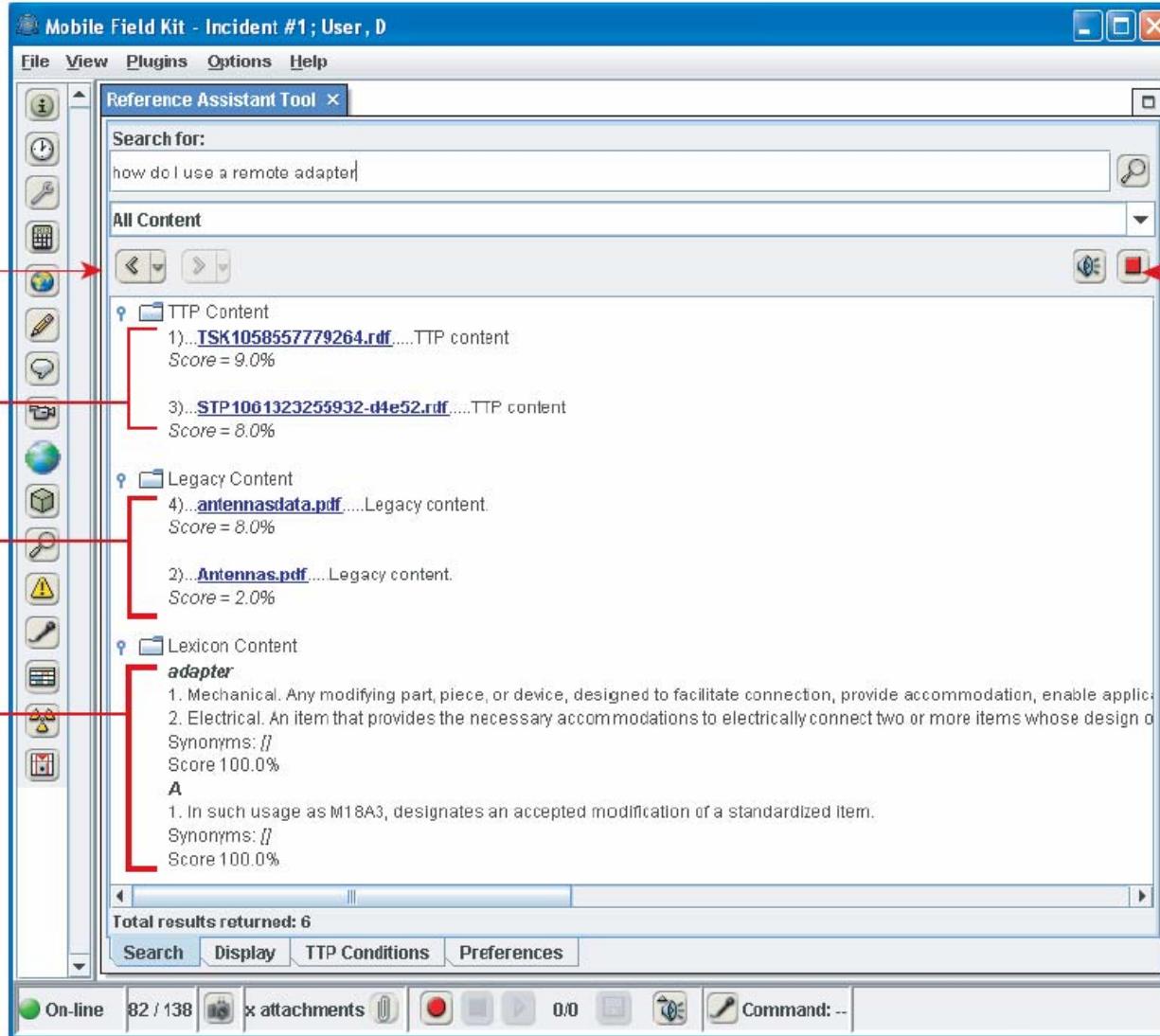
Synonyms: /

Score 100.0%

Total results returned: 6

Search Display TTP Conditions Preferences

On-line 82 / 138 x attachments 0/0 Command: --

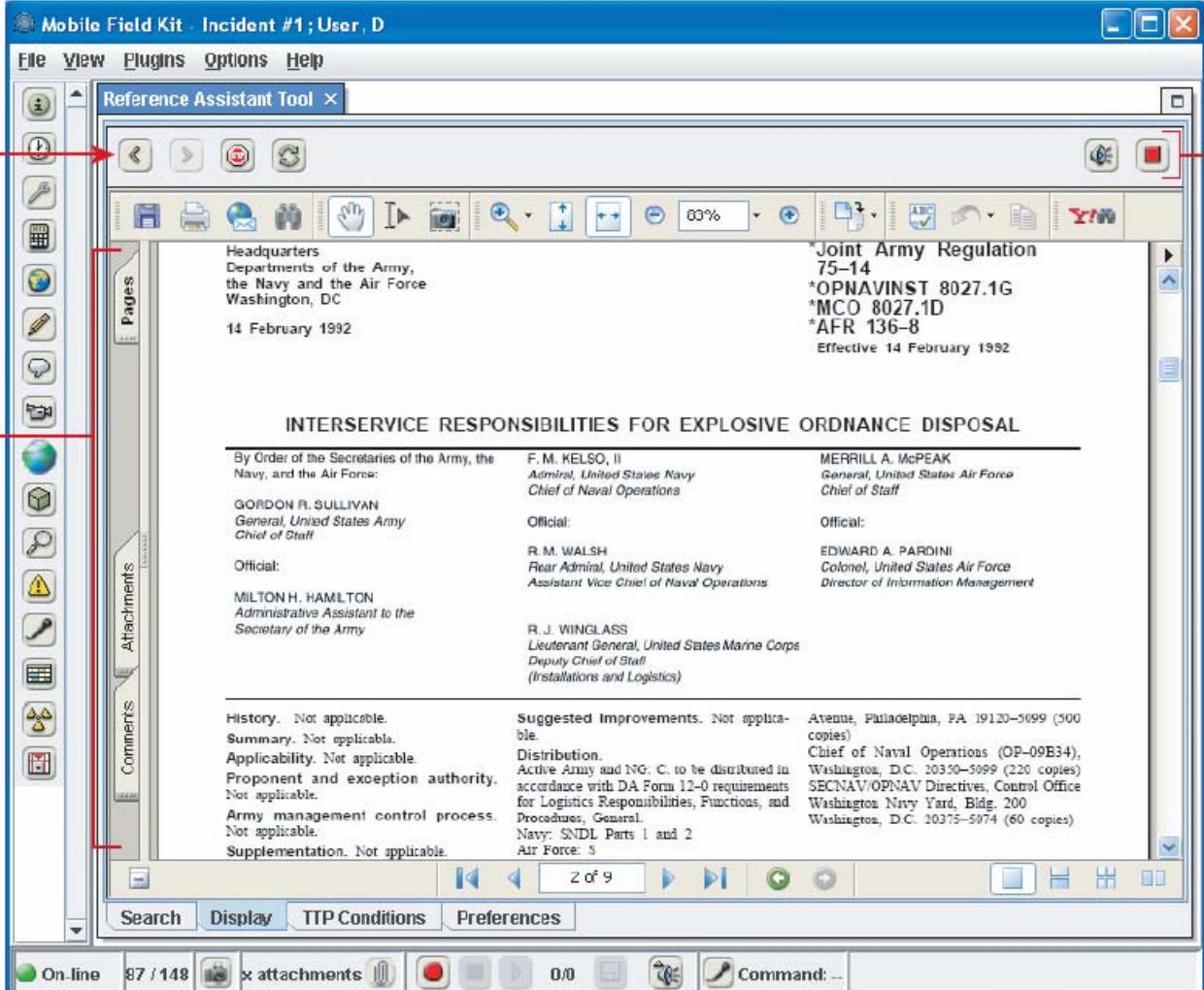


Reference Assistant Tool (RAT) Demonstration

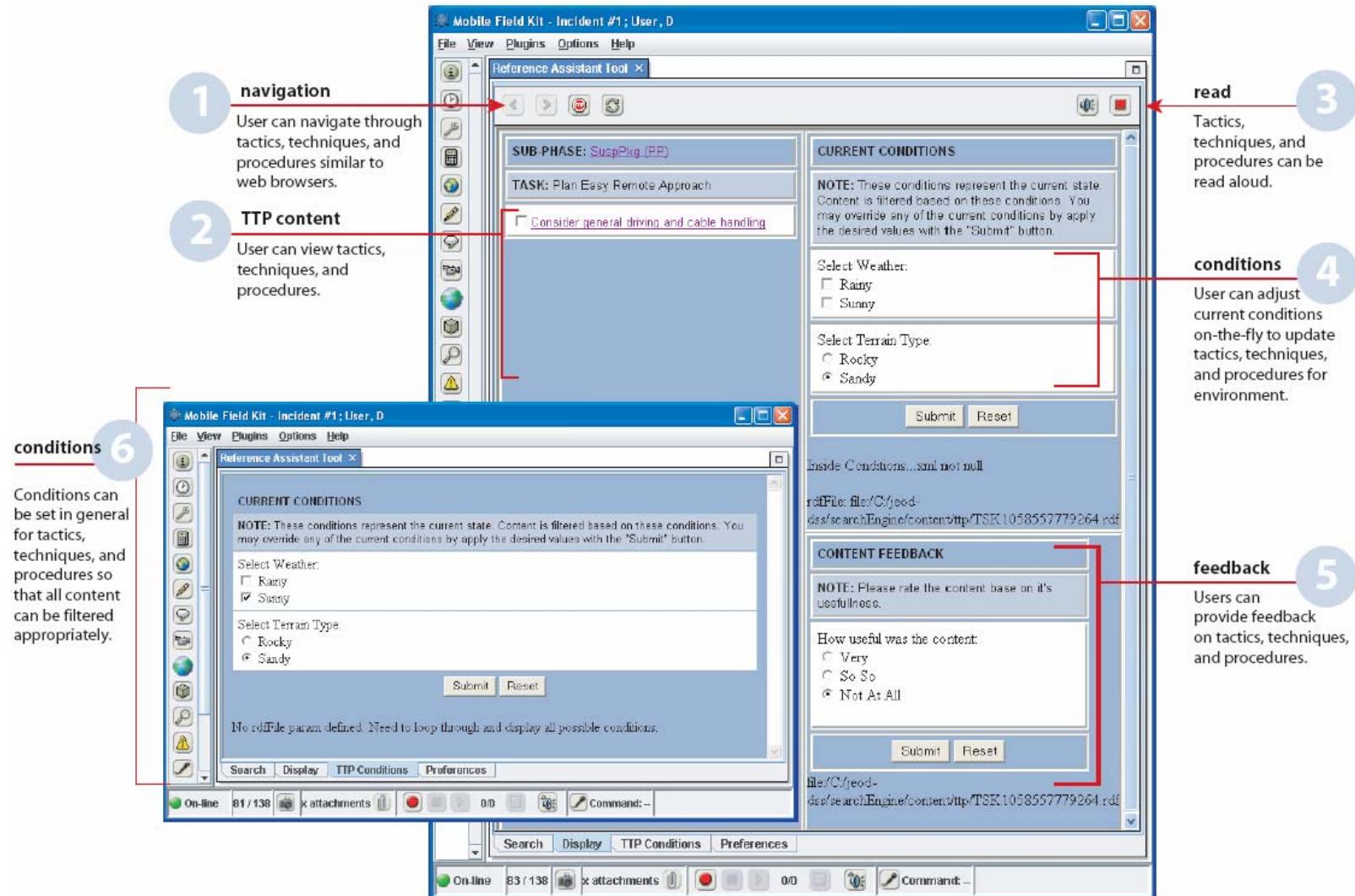
navigation 1
 User can navigate through content similar to web browsers.

browser 2
 Standard browser (IE or Firefox) is embedded. This allows for more types of content to be displayed and abides by a common look and feel for the end user.

read 3
 Content can be read aloud. Multiple formats supported (HTML, XML, XHTML, RDF, PDF, RTF, PPT, TXT, and XLS).



Reference Assistant Tool (RAT) Demonstration



1 navigation
User can navigate through tactics, techniques, and procedures similar to web browsers.

2 TTP content
User can view tactics, techniques, and procedures.

3 read
Tactics, techniques, and procedures can be read aloud.

4 conditions
User can adjust current conditions on-the-fly to update tactics, techniques, and procedures for environment.

5 feedback
Users can provide feedback on tactics, techniques, and procedures.

6 conditions
Conditions can be set in general for tactics, techniques, and procedures so that all content can be filtered appropriately.

Conditions can be set in general for tactics, techniques, and procedures so that all content can be filtered appropriately.

- **Challenge**
 - Save Warfighter Lives
 - Reduce Cost for Procedural Instructional Content
- **Context**
 - IEDs constantly evolving
 - JEOD ACTD – globally deployable DSS
- **Military Learning Objective**
 - Provide contextualized JIT training to warfighters in the field
- **Semantic Web Background**
 - Next Evolution of the Web (OWL)
 - Standards Layers allow automation based on content
- **Military Learning Solution**
 - DJAS as a prototype
 - JEOD DSS design/development